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Abstract

This paper analyzes the impact that terms of trade (TOT) are likely to have on the growth of the People's Republic of China's (PRC) neighboring countries. Two scenarios employing a dynamic computable general equilibrium framework are considered: (i) a convergence scenario, where historical trends are projected; and (ii) a baseline scenario, where technological progress in the PRC is placed in line with that of the United States (US). The results show that the PRC's technological convergence leads to increased world prices for mining products, and lower world prices for manufactures, especially those exported extensively by the PRC. On the whole, however, the effects on the growth and TOT of the PRC's neighboring countries are relatively small. The modelling framework used in this study explicitly captures the various offsetting effects that dampen the impact on TOT and contribute to the small impact on growth. In addition, the additional capital required to finance the PRC's growth comes predominantly from domestic savings, placing little pressure on the global supply of capital. Thus, an awakening PRC is unlikely to make a dramatic entrance despite the country's overall positive impact on the region – although there is nothing to fear, there is also only little to gain.

Keywords: computable general equilibrium, multicountry models, People's Republic of China, terms of trade

JEL Classification: F17, F47, C68

1. Introduction

The People's Republic of China's (PRC) economy is now the biggest in Asia. As its role increases, its impact on neighboring economies is also likely to increase. Therefore, the issue as to whether Asia is a locomotive for growth depends—to some degree—on how the PRC grows and how this growth affects the region. This paper analyzes the impact of an awakening PRC on the terms of trade (TOT) and growth of its neighbors. This paper focuses on TOT because a number of studies[1] have already examined growth spillovers.[2]

Issues associated with a country's TOT have been a longstanding concern in development economics. In the 1950s and 1960s, the concern was about deteriorating primary commodity prices relative to manufactured goods, which harmed developing countries (Prebisch 1950; Singer 1950). In the 1970s, the concern shifted to relative prices within manufactured goods. Since manufactured exports from developing countries typically have a lower technological content, the concern was that their prices would fall relative to the prices of exports from developed countries (Singer 1971; Wood 1997; Maizels, Palaskas, and Crowe 1998).

Since the mid-1990s, the impact of an awakening PRC on the world has become a prominent topic in economic discussions. The PRC became a net importer of crude oil in the early 1990s. Since then it has relied heavily on energy from overseas, importing one-third of its consumption of crude oil in recent years. The rapid growth of its manufacturing industries also brought about increased demand for primary commodities such as iron ore and base metal products. The PRC's increasing demand for energy and primary inputs, as well as the rapid growth of its manufactured exports, has raised concerns about the impact of TOT on the growth of both developing and developed countries.

To analyze the impact of the PRC's rapid development on the growth and TOT of its neighboring countries, a global dynamic computable general equilibrium (CGE) model that assesses 11 countries[3] individually and the rest of the world (ROW) collectively is used. The advantage of using a CGE framework is that it represents in detail the structures of the economies under review. With the rapid globalization of the past 3 decades, the links between the world's economies have become more sophisticated, thereby increasing the complexity of analyzing TOT issues in particular. For example, if the PRC's demand for energy contributes to higher energy prices, then energy exporters' TOT are likely to enjoy a favorable change, while energy importers' TOT may deteriorate. The same would apply to primary products. Higher energy and commodity prices could lead to higher prices for manufactured goods as well, however, and these

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1 See, for instance, Eichengreen, Rhee, and Tong (2004); Fujiwara, Otsu, and Saito (2008); McKibbin and Woo (2003); Mai, Horridge, and Perkins (2003); Phelps (2004); and Sachs and Woo (2003).

2 Exceptions include Kaplinsky (2006) and Phelps (2004), although neither of these two studies uses a multi-country modeling approach.

3 The nine largest Asian countries (PRC, India, Indonesia, Japan, Republic of Korea, Malaysia, Philippines, Singapore, and Thailand) plus Australia and the United States (US).

effects need to be considered. It follows that the effects of the PRC's increasing demand for energy and primary products on the TOT of its neighboring countries will depend to a large degree on the economic structures of these economies. The structural details contained within the CGE model used in this paper accommodate the sophisticated nature of the issues at hand.

The paper is organized into six sections. Section 2 discusses the methodology and data. Section 3 introduces how the PRC's technological convergence with developed countries is simulated. The effects of the PRC's convergence on neighboring countries are presented in Sections 4 and 5, with Section 4 analyzing the TOT effects and Section 5 assessing income and industry effects, as well as the results of sensitivity tests. A final section concludes.

2. Methodology and Data

The PRC's increasing demand for energy and primary inputs is placed in the context of its convergence in per capita income with developed countries, achieved through technological progress. Improved technological progress underlies rapid economic growth in the PRC, and hence rapid growth in Chinese demand for energy and other primary inputs. Historical simulation was conducted to estimate the degree to which the PRC had to catch up with technological developments during 1997–2005. The purpose of the historical simulation is to calibrate the model with historical data, and to estimate quantitatively the PRC's technological progress relative to developed countries. The estimated speed of technological progress during the historical period is then used to simulate the effects of the PRC's technological convergence with developed countries, and to analyze the effects of the convergence on the PRC and its neighboring countries from 1999 to 2010. Finally, the robustness of the analysis was tested by supplementing the simulation of the PRC's convergence in technology with two other simulations: (i) a change in user preferences toward imported goods, especially manufactured goods that affect prices of manufactured exports; and (ii) an alternative scenario of the PRC's energy efficiency that affects its demand for energy and therefore world prices for energy products.

The simulations were conducted using the MONASH Multi-Country (MMC) model. The MMC model is a global dynamic CGE model of 11 countries and the ROW. The model is described in detail in Mai (2004).

2.1 Historical Simulation

The most important data for this analysis has been unobserved—technological convergence. Historical simulation operates in reverse fashion to standard policy simulation. In a standard policy simulation, quantities and prices of production outputs and inputs, consumption, and international trade are typical endogenous variables, while production technology and consumer preferences are typical exogenous variables. In these simulations, the model is informed of a change in a technology or policy variable (such as a deterioration in agricultural productivity or a tariff cut), and the model

calculates the resulting changes to gross domestic product (GDP), consumption, output, employment, and other endogenous variables.

In a historical simulation, the model operates in a reverse fashion—with GDP, production, consumption, and international trade as the exogenous variables, and the corresponding technical and preference change variables (such as multi-factor productivity) as the endogenous variables. The model is informed of changes in GDP, consumption, investment, and other observed variables during a historical period. It can then impute the necessary changes in technology and preferences.[4]

2.2 Data sources and Related Issues

The main sources of data for the macroeconomic variables are World Development Indicators published by the World Bank and UNSTATS published by the United Nations. These two sources are supplemented by country sources, such as the PRC National Statistical Bureau, the Singapore Department of Statistics, and the US Bureau of Economic Analysis (see the list of statistical references at the end of this paper). The GTAP version 5 database (Dimaranan and McDougall 2002) is the main source of input–output and international trade data for the MMC model.

Table 2.1 presents the growth rates of key macroeconomic variables during 1997–2005 for each country in the model. The data from various sources have been adjusted to be consistent with each other and with the model database for 1997. The table shows that the PRC enjoyed high GDP growth of about 9% per year from 1997 to 2005. Within gross national expenditure (GNE), real investment (or gross fixed capital formation) grew much faster than real private and government consumption, indicating a high savings rate in the PRC. Both export and import volumes grew at double-digit rates, much faster than real GDP and GNE. The volume of exports grew faster than the volume of imports, contributing to the PRC's current account surplus during the period.

2.3 The PRC's Technological Progress During 1997–2005

Table 2.2 summarizes employment and output data for the PRC and the US. It also shows estimates of technological progress during 1997–2005, based on results from the historical simulation.[5] The table shows that the PRC's total primary-factor-augmented productivity grew rapidly during this period. At the aggregate level, the PRC's total primary-factor-augmented productivity grew by 4.4% per year during 1997–2005, much faster than the 1.3% annual growth rate for the US. By industry, technological progress for all sectors was faster in the PRC than in the US, except for agriculture and communications.

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[4] The historical simulation technique using a CGE model is described in detail in Dixon and Rimmer (2002). Applications to trade that use this technique to estimate technology and preference changes include Dixon, Menon, and Rimmer (2000); and Mai, Horridge, and Perkins (2003).

[5] In this study, technological progress is defined as an improvement in total primary-factor-augmented productivity, which is defined as an increase in output relative to a weighted average of all primary-factor inputs.

From the estimations, the mining sector in the PRC substantially improved. The historical simulation covers a period during which the PRC overhauled its oil and gas industry to create vertically integrated oil giants that can compete with international rivals (Yan 1998; Mai 2002). Because of reforms, however, employment in the mining industry significantly fell during the period.

3. The PRC's Technological Convergence

This section explains how the PRC's technological convergence with developed countries was simulated, as well as the effects of the convergence on the PRC's real GDP, GNP, and TOT.

3.1 Simulating the PRC's Convergence

The historical simulation outlined in Section 2 represents a "real" scenario from 1997–2005, in which the PRC continued its convergence in technology with developed countries—a journey that began in 1978. To analyze the effects of the technological convergence during 1997–2005, the "real" scenario was compared with a baseline in which the PRC does not catch up technologically. To obtain this baseline, it was assumed that, on average, the PRC's productivity improves in line with that of the US, as estimated for 1997–2005.

In the baseline, the PRC's national productivity was assumed to be growing at 1.3% that of the US, while the sectoral pattern of productivity improvement estimated in the historical simulation was maintained. In simulating the PRC's convergence, total average annual productivity growth was assumed to be 3.1%, and broken down as follows: 2.4% productivity growth for agriculture, 5.0% for mining, 3.7% for manufacturing, and 2.7% for services. The "real" scenario is extended to 2010 through a forecast simulation to see the effects in the long-term. The same forecast simulation from 2005–2010 has been done for the economies in the model. In this simulation, it was assumed that the PRC and the US continued their growth trend in 1997–2005. The trend rates of growth during 2005–2010 for countries affected by the 1997/98 Asian financial crisis were assumed to resemble those of 1990–2005 (Table 3.1).

The "real" scenario, consisting of the historical simulation for 1997–2005 and the forecast simulation for 2005–2010, forms the convergence scenario. By removing the annual technological progress for 2000–2010, the baseline is derived—a scenario where the PRC does not catch up with developed countries.

Figure 3.1 shows that the effects of the convergence are measured by the difference between the convergence scenario and the baseline, or the deviations of economic variables from their baseline levels in 2010. Table 3.2 presents a summary of the growth trend for key macroeconomic variables in the baseline scenario for the economies in the model.

3.2 Effects of the Convergence on the PRC's Real GDP and GNP

During 1997–2005, the PRC's average annual growth rate in real GDP was 8.9%. During the forecast period of 2005–2010, it was assumed that the PRC continued its historical growth trend of 8.9% per year. Table 3.2 shows that without technological convergence, the PRC's real GDP would grow at a rate of only 4.8% per year, much lower than the convergence rate of 8.9%. Figure 3.2 illustrates the different growth path the PRC would take with and without the technological convergence. With technological convergence, the PRC's GDP is likely to be over 50% higher in 2010 (Table 3.3).

In a long-run simulation such as this, it is assumed that aggregate employment (L) is determined by demographic factors and thus is not affected by the extra technical progress in the PRC. Accordingly, aggregate employment does not deviate from its baseline value,[6] and so does not contribute to the positive deviation in real GDP (Figure 3.3).

A positive deviation in capital stock, however, does contribute to the positive deviation in real GDP. The positive deviation in capital stock can be explained by the following capital market equilibrium condition:

$$\frac{Q}{P_g} = \frac{1}{A} * F_k(K/L) \quad (1)$$

The technical progress boosts the average capital rental (Q), reduces production costs (and thus P_g), and thereby generates increases in (Q/P_g). However, this effect is weak relative to the increase in $1/A$, the technological progress. This also implies an increase in K/L. It is assumed that technical progress in the PRC does not affect aggregate employment (L). Thus, K must increase.

Table 3.3 shows that the 44.2% increase in real GNP is smaller than that of real GDP following the PRC's convergence. This is mainly due to two factors. The first relates to the increase in capital income that partly underlies the increased GDP that accrues to foreigners, while the second relates to the decline in the TOT. All else being equal, deterioration in the TOT reduces the price of output, which includes exports but not imports, relative to the price of expenditure, which includes imports but not exports. Reductions in the price of output (or GDP) relative to the price of expenditure (or GNE), in most cases, cause real GDP to increase relative to real GNP.

3.4 Effects of the Convergence on the PRC's Terms Of Trade

The simulation results show that the PRC's TOT declines significantly as a result of the technological convergence (Figure 3.4). Starting from the same level in 1999, the PRC's TOT is about 10% lower by 2010 with the technological convergence than without it. In the baseline (without the PRC's convergence), the PRC's TOT grows at an average

[6] Although aggregate employment is exogenous, employment by industries is endogenous as labor is mobile between industries and/or sectors within the PRC.

annual rate of 0.7% from 1999 to 2010. With technological convergence, the PRC's TOT declines at an average annual rate of 0.3% during the same period.

Figure 3.5 shows that the decline in the PRC's TOT is caused by a strong decline in its export price index, combined with a moderate increase in its import price index. More specifically, in 2010, the 10% decline in the TOT is caused by a decline in the export price index of nearly 9% and an increase in the import price index of nearly 2% (Table 3.4). The main factor that influences the PRC's export prices is the strong technological progress in the convergence scenario relative to the baseline. The improvement in the total primary-factor-augmented productivity in the PRC reduces production costs, leading to reduced output and export prices.

The decline in the export price index for agriculture products is less than that for manufactured goods (Table 3.4). This is because improvement of productivity in the agriculture sector is estimated to be slower than that in the manufacturing sector in the historical simulation. Furthermore, the agricultural sector uses land as a primary-factor input. In these simulations, additional technological progress was not allowed to affect the amount of land available for producers. Fixing the availability of land limits the agricultural sector's ability to reduce costs.

Although the improvement of productivity in the mining sector was larger than that in the manufacturing sector, the sector's production is significantly limited by the availability of resources, especially with regard to the oil industry. In the simulation, it was assumed that the PRC's technological convergence had little influence on its oil production. Even though the convergence brings about a higher demand for oil, the PRC's oil production continues its resource-limited growth of 2% per year.[7] This means that the PRC's oil price rises with the strong increase in demand caused by the technological convergence.

The decrease in the export price index for the mining sector is due to a decline in the export price for coal. Continuing its historical trend, coal becomes dominant in the PRC's mining exports by 2010 in the baseline (Table 3.4). With technological convergence, the PRC's export price for coal is lower than in the case of no technological progress. The limited availability of resources for coal is less of a constraint in the PRC than that for oil and gas.

The shares of mining and agricultural products in the PRC's total exports, however, are insignificant compared with that of manufactured goods. Manufactured goods comprise the bulk of the PRC's total exports.[8] The 9-percentage-point fall in the export price index is therefore mainly attributable to the fall in the export price index for manufactures (Table 3.4).

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[7] The PRC's self-sufficiency policy meant that the country reached its domestic-resource limit before it turned to imports on a large scale in the early 1990s.

[8] The service exports presented in Table 3.4 include only cross-border transactions, or the first two modes of trade in services. The bulk of the services trade involves movement of people and capital across borders—the third and forth modes of service trade, which are not explicitly discussed in this study. Trade in services therefore appears to be insignificant compared to the merchandise trade in Table 3.4.

The 2-percentage-point rise in the PRC's import price index is mainly attributable to large increases in the prices for agricultural and mining products. As a result of the PRC's convergence, the import price index for manufactured goods rises only slightly by about 0.5%. The import price index of agriculture rises significantly by 4%, and mining rises by 14%. This is because the PRC's convergence leads to increased demand for imported energy and primary inputs such as oil, iron ore, wool, and cotton.

Oil, in particular, registers the largest rise in the import price as a result of the PRC's technological convergence. In the simulation, the PRC's convergence is assumed not to have a significant impact on oil production in the PRC and in other countries. Oil production is assumed to be mainly determined by supply-side factors such as resource constraints in the PRC and monopolistic production behavior in the Middle East.

3.5 Effects of Convergence on the PRC's Economic Structure

As a result of the technological convergence, the PRC's exports increase by about 46% and imports by about 45% relative to their respective baseline levels in 2010. Imports and exports of all commodities and services rise relative to their baseline levels (Table 3.5). On the export side, the increase in manufactured exports is larger than those in agricultural and mining exports. By contrast, the increase in manufactured imports is smaller than those in agricultural and mining imports.

The deviation from the baseline of value-added by industries shows a similar pattern to that of the export volumes. Table 3.5 shows that, following the technological convergence, value-added in all sectors expands. However, value-added of the manufacturing and services sectors rise more than that of the agricultural and mining sectors.

In the convergence scenario, the PRC's productivity is assumed to improve in all sectors relative to the baseline. The improvement in the agricultural sector is, however, slower than that in the manufacturing and services sectors. Furthermore, the agricultural sector has land as a fixed factor, limiting its scope to expand production. Although the mining sector experiences the largest increase in productivity, its production is significantly limited by resource constraints, as discussed in Section 3.3. Thus, technological convergence causes the PRC to increase its specialization in manufacturing. Due to resource constraints, the PRC becomes more dependent on imports for agricultural and mining products.

4. Terms of Trade Effects of the PRC's Convergence on Neighboring Countries

In Section 3, the effects of the PRC's rapid economic growth from 1999 to 2010 is simulated, and stimulated by its technological convergence. As a result, the prices of agricultural and mining products in the PRC rise relative to their levels without convergence, while the price of manufactures fall relative to their no-convergence levels.

Consequently, the PRC, as a net importer of agricultural and mining products, and a net exporter of manufactures, experiences a significant fall in its TOT. This section analyzes the effects of PRC's technological convergence on the TOT of neighboring countries.

Table 4.1 shows that, as a result of the PRC's technological convergence, the TOT of countries rich in resources—such as Australia, Indonesia, and the ROW—improve. The TOT for the US also improves. India, having an endowment and production pattern similar to that of the PRC, suffers the second largest deterioration in its TOT after the PRC.

The magnitude of the TOT effects, however, is generally small for neighboring countries because the PRC's convergence has both positive and negative influences on export and import price indexes. The outcome for neighboring countries is examined in more detail.

4.1 Japan

The PRC's technological convergence has a small negative impact on Japan's TOT. The deviation of Japan's TOT from its baseline level in 2010 is –0.8%, or about 14 times less than that for the PRC (Table 4.1).

On the export side, the deviation from the baseline of the export price index is 0.1%. This is due to the off-setting effects caused by a fall (negative deviation from baseline) in the export price index for manufactures and a rise (positive deviation from baseline) in the export price index for services (third column of Table 4.2). Japan's export price index for services rises because the services trade in the model includes transport and insurance margins demanded by international trade transactions. With the PRC catching up in technology, total world trade expands, leading to increased demand for transportation and insurance services.

With the very small deviation in the export price index, the negative deviation of Japan's TOT is mainly attributable to a positive deviation in the imports price index of 0.9%. The positive deviation in Japan's import price index, in turn, is caused by a significant rise in import prices for agricultural and mining products. In particular, the price index of Japan's mining imports rises by 11% due to the PRC's catching-up (column [b] of Table 4.3).

However, the effects on Japan's import price index of the rise in prices for mining imports are largely offset by the fall in prices for manufactured imports (column [c] of Table 4.3). Prices for manufactured imports fall mainly due to a fall in the price of manufactured imports from the PRC. Although the rise in prices of mining imports exceeds in absolute terms the fall in prices of manufactured imports, manufactured imports have a dominant share in Japan's total imports (column [a] of Table 4.3). Thus, overall, Japan's import price index rises moderately, leading to a small fall in the TOT.

4.2 The Republic of Korea

The Republic of Korea (Korea) also experiences a small negative deviation in its TOT due to the PRC's technological convergence. The deviation in Korea's TOT from baseline in 2010 is –0.7%, similar to that for Japan. However, both Korea's import and export price indexes increase more than those for Japan (Table 4.1).

Although the PRC's convergence tends to bring down the worldwide price for manufactures, Korea's export price index for manufactures rises because its manufactured exports are oil-intensive. As the PRC's convergence pushes up prices for mining products (especially crude oil), the prices for petroleum and coal products that use mining products as the main intermediate input also rise significantly. Since petroleum products comprise a significant share of Korea's total exports (compared with Japan), this leads to a small rise in Korea's export price index for manufactures.

The import price index for manufactures falls less in Korea than in Japan because Korea imports a smaller proportion of manufactures from the PRC than Japan does (Figure 4.1). The PRC's export price index for manufactures falls significantly as it catches up with developed countries in production technology. Consequently, Japan, importing a larger proportion of manufactures from the PRC, experiences a larger fall in its import price for manufactures.

4.3 India

The PRC's convergence leads to an overall fall in export prices and to a rise in import prices in India. As a result, India's TOT falls relative to its value in the baseline by 3.5% in 2010. This is a larger change than those simulated for other neighboring countries of the PRC (Table 4.1).

On the import side, the import price index for mining rises in India as in Japan and Korea. However, unlike for Japan and Korea, the rise in the import price index for mining is not offset by a fall in the import price index for manufactures (third column, Table 4.5). In India's case, two factors contribute to a rise in the import price index for manufactures: a significant share of petroleum and coal products in total imports, and a small share of manufactured imports from the PRC in total manufactured imports.

India has the largest share of petroleum and coal products in total imports among the nine economies that are analyzed in detail in this paper. The large rise in the import price for petroleum and coal products following the PRC's convergence therefore places significant upward pressure on India's import price index for manufactured goods.

Furthermore, India imports less manufactured goods from the PRC than the other economies presented in Figure 4.1. The large fall in the price of manufactured imports from the PRC is therefore not sufficient to offset the upward pressure on India's import price index for manufactured goods discussed earlier.

On the export side, the downward pressure that the PRC's convergence places on the export price index for manufactured goods plays a more significant role for India than for

the other countries analyzed in this paper. This is because India's exports concentrate on labor-intensive manufactures, such as clothing and other wearing apparel. As a result of the PRC's convergence, these products have larger price declines than do the capital-intensive ones, such as motor vehicles and nonferrous metals (Table 4.6).

To summarize, India's TOT worsens mainly due to the following characteristics in its trade structure: (i) a significant share of mining products in total imports, (ii) a large share of petroleum and coal products in total imports, (iii) a small share of manufactured imports from the PRC in total manufactured imports, and (iv) a concentration of labor-intensive manufactures in its total exports.

4.4 Indonesia

The story is quite different for Indonesia. As a result of the PRC's convergence, Indonesia's TOT improves by 2.8% in 2010 (Table 4.1). Table 4.7 shows that the improvement in TOT for Indonesia is mainly attributable to a large rise in its export price index. Indonesia's export price index rises by 4.4% in 2010, much more than the rise in its import price index of 1.6% (Table 4.7). For Indonesia, the rise in the export price index of mining products following the PRC's convergence plays a significant role. Compared with other countries, Indonesia has a significant share of mining products in its total exports.

4.5 Malaysia

The simulation results show that the PRC's convergence has little impact on Malaysia's TOT, which is down 0.1% in 2010 (Table 4.1). For Malaysia, changes are small to both the export (–0.2%) and import (–0.1%) price indexes (Table 4.8). On the export side, electronic equipment comprises the dominant share in Malaysia's total exports.

Following the PRC's convergence, prices for electronic equipment fall significantly. Malaysia's export price index for manufactures also falls as a result (Table 4.8). On the other hand, mining products comprise a significant share of total exports in Malaysia—although not as large as in Indonesia. As a result, the effects of the rise in the export price indexes for agriculture, mining, and services almost completely offset the effects of the fall in the export price index for manufactures. Thus, the PRC's convergence leads to a very small change in Malaysia's export price index.

Similarly, on the import side, a small fall in the import price index for manufactures combined with a dominant share of manufactures in total imports has a negative effect on Malaysia's import price index. However, this negative effect is almost completely offset by the effect of the rise in the import price indexes for agriculture, mining, and services (Table 4.8).

4.6 Singapore

The PRC's convergence has little impact on Singapore's TOT (Table 4.1), with both the export and import price indexes rising relative to baseline values by similar amounts (Table 4.9).

Petroleum and coal products have a significant share in Singapore's manufactured exports (Table 4.9). The large rise in the export prices for petroleum and coal products therefore places upward pressure on Singapore's export price index for manufactures. This upward pressure is, however, largely offset by a fall in export price for electronic equipment. The result is a small rise in the export price index for manufactures. The small rise in the export price index for manufactures reinforces the rise in the export price for services,[9] leading to an increase in Singapore's overall export price index.

On the import side, the downward pressure placed on the import price index for manufactures by the fall in the import price for electronic equipment more than offsets the upward pressure caused by the rise in import prices for petroleum and coal products. This leads to a small fall in the import price index for manufactures (Table 4.9). The fall in the import price index for manufactures offsets the effects of a large rise in the import price index for mining products, leading to only a small rise in the overall import price index for Singapore.

To summarize, the positive factors that have a strong influence on Singapore's TOT are (i) a significant share of petroleum and coal products in total exports combined with a large rise in the export price index for these products, (ii) a dominant share of electronic equipment in total imports combined with a fall in the import price index for these products, and (iii) a large share of services in total exports combined with a rise in the export price index for services. The negative factors that have a strong influence on Singapore's TOT are (i) a significant share of mining products in total imports combined with a large rise in the import price index for these products, (ii) a significant share of petroleum and coal products in total imports combined with a large rise in the import price index for these products, and (iii) a dominant share of electronic equipment in total exports combined with a fall in the export price for these products.

These offsetting factors of more or less equal strength result in a small overall effect of the PRC's convergence on Singapore's TOT.

4.7. Thailand

As a result of the PRC's convergence, Thailand's TOT falls relative to its baseline value by –1.5% in 2010 (Table 4.1). The export price index falls by a relatively small –0.3%, while the import price index rises by 1.2% in 2010 (Table 4.10).

[9] As discussed, the PRC's convergence leads to increased world trade (Table 5.1) that, in turn, leads to increased demand for international trade margins such as transport and insurance services. The export price index for services therefore rises.

For Thailand, a dominant share of electronic equipment and other machinery and equipment in total exports combined with a fall in the export prices for these products leads to a fall in the export price index for manufactures. This negative effect on Thailand's export price index is largely offset by the effect of a rise in the export price index for services. The result is a very small decline in the overall export price index for Thailand (Table 4.10).

Similarly, on the import side, a dominant share of electronic equipment and other machinery and equipment in total imports combined with a fall in the import prices for these products leads to a fall in the import price index for manufactures. This negative effect on Thailand's import price index offsets partially the effect of a large rise in the import price index for mining products. The result is a moderate rise in the import price index of 1.2%.

4.8 Philippines

The simulation results show that the PRC's convergence results in a fall of –0.9% in the Philippine's TOT (Table 4.1). The fall in TOT is attributable to a rise in the import price index of 0.9% (Table 4.11), with the export price index changing little.

On the export side, a dominant share of electronic equipment in total exports combined with a fall in the export prices for these products leads to a fall in the export price index for manufactures. This negative effect on the Philippine's export price index is offset by the effect of a rise in the export price index for services (Table 4.11).

On the import side, a dominant share of electronic equipment in total imports combined with a fall in the import prices for these products leads to a fall in the import price index for manufactures. This negative effect on the Philippine's import price index partially offsets the effect of a large rise in the import price index for mining products. The result is a rise in the import price index of 0.9%.

To summarize, the two positive factors that have a strong influence on the Philippine's TOT are (i) a dominant share of electronic equipment in total imports combined with a fall in the import price for these products, and (ii) a rise in the export price index for services. The two negative factors that have a strong influence on the Philippine's TOT are (i) a dominant share of electronic equipment in total exports combined with a fall in the export price for these products, and (ii) a large rise in the import price index for mining products.

5. The Growth Effects of the PRC's Convergence on Neighboring Countries

5.1 Effects on Export Volumes and Production Mix

The PRC's convergence leads to small changes in the total export volumes of its neighboring countries (Table 5.1). While the neighboring countries export less to their

traditional markets such as the US, Japan, and the ROW, they export more to the PRC (Table 5.2).

Table 5.2 shows that in the US, Japan, and the ROW markets, the PRC's convergence leads to a large increase in imports from the PRC, while imports from all other countries and/or regions fall. However, for the PRC's neighboring countries, this negative impact on their exports is greatly softened by a large increase in their exports to the PRC.

For Korea and Japan, which send a larger proportion of their exports to the PRC than other countries presented in Figure 5.1, the fall in their exports to other markets is more than compensated for by the increase in their exports to the PRC, leading to an increase in their total export volumes. In terms of commodity composition, exports of manufactures fall for most of the PRC's neighboring countries, except Korea and Japan. Exports of agricultural and mining products and services, on the other hand, rise as a result of the PRC's convergence (Table 5.1).

Again, the decline in the export of manufactures is due to declining exports of these products to non-PRC markets. The neighboring countries' exports of manufactures to the PRC market increase as a result of the convergence. Indeed, the PRC's convergence not only leads to a large increase in its export of manufactures, convergence also leads to a large increase in its import of manufactures, primarily electronic equipment, other machinery and equipment, and chemical–rubber–plastic products.

Table 5.3 shows that electronic equipment, other machinery and equipment, and chemical–rubber–plastic products comprise large shares of both the PRC's total exports and imports. For these products, the PRC is part of a production network. For example, the production in the PRC of electronic equipment requires imports of electronic equipment from its neighboring countries as intermediate inputs.

The technological convergence intensifies the PRC's role in these networks. The convergence leads to a large increase in the neighboring countries' exports (imports) of electronic equipment, other machinery and equipment, and chemical–rubber–plastic products to (from) the PRC; on the other hand, the neighboring countries' total exports (imports) of these products to the world either fall or increase at slower rates (Table 5.3). Therefore, as a result of the PRC's convergence, the neighboring countries reduce their trade in such products with non-PRC partners and trade more with the PRC.

Table 5.4 shows that for neighboring countries, the PRC's convergence leads to a pattern of change in the production mix similar to that for exports. Other than a few exceptions, value-added for manufactures contract, while that for the primary and services sectors expand for the neighboring countries.

5.2 Why are the GDP Effects Small?

The impact of the PRC's convergence on the real GDP of neighboring countries is mixed, but overall very small—less than one percentage point for all but India. India's real GDP

decreases by about 1.0% as a result of the PRC's technological convergence (Table 5.5).

Output can expand only when there are increases in production factors employed (an increase in L or K) or improvement in productivity (a reduction in A). In the simulation of the PRC's convergence, the following assumptions are made: (i) aggregate employment is determined by long-run factors, such as population growth and labor force participation rates, and therefore is exogenous in the simulation of the PRC's convergence in technology; and (ii) productivity of the neighboring countries is also exogenous. Thus, the changes in output mainly come from changes in capital stock employed.

From the equilibrium condition in the capital market, or equation (1), with the L and A exogenous, changes in capital stock (K) are mainly determined by changes in rental price relative to output price (Q/P_g). Q/P_g, in turn, is a function of the rate of return on capital and TOT.[10]

Table 5.5 shows that the PRC's convergence also leads to small changes in the neighboring countries' rate of return on capital. This is because the PRC has a high savings rate, as is well known. Foreign capital accounts for a very small proportion of the PRC's total capital stock. When the PRC converges with developed countries in technology, the additional capital required to finance the increase in GDP comes mainly from domestic savings.

The small changes in rates of return to capital and TOT lead to small changes in the Q/P_g term, and thus to small changes in capital stock. As a result, the PRC's convergence leads to small changes in real GDP for the neighboring countries.[11]

It is natural to raise the question that if the PRC can finance its high growth out of domestic savings, why is it important for the PRC to open its economy to foreign investment? The answer lies in the spillover effects of foreign investment. Foreign investment brings about more advanced production technology as well as management skills. The key benefit of foreign investment is improvement in productivity as other players in the host industry catch up with the performance standards set by foreign investors (Mai 2004; Menon 1998).[12] The fact that domestic, rather than foreign, savings will fuel most of the PRC's future growth should also allay the fears of some of its

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[10] The terms Q/P_g can be expanded to where P_2 is asset price. The first term is rate of return on capital. The second term is a function of TOT because P_2 includes import prices but not export prices, and P_g includes export prices but not import prices.

[11] Changes in indirect taxes will also affect real GDP. That effect is small in this simulation and is therefore ignored in the discussion.

[12] It would be interesting to see how the simulation results would change if productivity in the PRC and its neighboring countries responded endogenously to flows of FDI. While there are many theories about why FDI would improve productivity, empirical estimates of such productivity improvement are scarce. Further modelling research on this issue is important, but beyond the scope of this paper.

neighbors that compete for similar types of foreign direct investment (FDI). Some of the member countries of the Association of Southeast Asian Nations (ASEAN), in particular, have expressed concern that the PRC's growth has occurred at the expense of FDI flowing into their home countries. The results presented here suggest that even if this were true in the past, it is unlikely to be the case in the future.

5.3 Effects on GNP

The effects of the PRC's convergence on real GNP in neighboring countries are presented in the first row of Table 5.5. For the PRC, the convergence leads to a much smaller increase in real GNP than in real GDP. For the neighboring countries, the results vary.

The difference between the effects on real GDP and GNP can be largely explained by each country's respective TOT. As discussed earlier, an improvement (deterioration) in the TOT increases (reduces) the price of output, which includes exports but not imports, relative to the price of expenditure, which includes imports but not exports. Increases in the price of output (or GDP) relative to the price of expenditure (or GNE) will, in most cases, cause real GNP to increase relative to real GDP. Such is the case for the PRC and most of the countries under review.

Another factor that explains the difference between real GDP and GNP is net income from abroad. As a result of the PRC's convergence, the PRC's rental price for capital rises significantly, while rental prices for capital in other countries either fall slightly or remain largely unchanged. Those countries that hold a larger proportion of their outward investment stock in the PRC therefore benefit more from its convergence.

For Singapore, real GNP rises notably more than real GDP, even though Singapore's TOT declines as a result of the PRC's convergence. This is because Singapore is among the 10 largest source countries for foreign investment in the PRC. Furthermore, Singapore's outward stock of foreign investment is very large relative to its GDP.

Finally, two sensitivity tests were conducted to check the robustness of the results. Changes of assumptions about user preferences in favor of imports and the PRC's energy efficiency did not affect the main findings to any significant degree.

6. Concluding Comments

The PRC's rapid economic growth generates both positive and negative effects on the TOT of neighboring countries. Simulations using the MMC model show that technological convergence and the resulting rapid economic growth in the PRC leads to (i) an increase in the world price for energy and primary inputs; (ii) a decrease in the world price for manufactured goods; and (iii) expanded world trade and therefore an increase in the world price for services exports such as transportation and financial services.

These changes in world prices have positive and negative effects on the TOT of neighboring countries, depending on each country's respective economic structure (Table 5.6). The historical simulation demonstrated that neighboring countries responded to the rapid growth of the PRC by expanding their trade and investment linkages with it (e.g., the network of production for electronic and other goods in the region). This, in turn, strengthened the positive effects on their TOT, leading to an overall small improvement in the TOT, despite the increase in the world price for energy and primary inputs.

The overall impact on exports of neighboring countries is also small. While the PRC replaced some of the neighboring countries' exports in their traditional markets, in the process, the PRC itself became an important export destination for these neighboring countries. As part of production networks involving neighboring countries, its convergence increases imports into the PRC of not only agricultural and mining products, but also manufactures and services.

The impact of the PRC's convergence on the real GDP of its close neighbors is also small. There are two main reasons for this. The first is that the additional capital required to finance the increase in the PRC's real GDP comes mainly from domestic savings. Foreign capital constitutes a very small proportion of the PRC's total capital stock. While rapid growth in the PRC places significant pressure on the world's supply of natural resources, it places little pressure on the global supply of capital. This should also allay the fears of some of its neighbors which compete for similar types of FDI (e.g., ASEAN countries) that future growth in the PRC may occur at the expense of FDI flowing into their countries. The second reason relates to the fact that any productivity improvements induced by an expansion in trade and investment flows have not been taken into account in this study. If this factor is taken into account, the PRC's convergence could have led to a larger positive impact on the real GDP of neighboring countries.

The impact of the PRC's convergence on neighboring countries' real GNP—a better welfare measure than real GDP—is small. There are also two reasons for this. The first is that the overall impact of the PRC's convergence on neighboring countries' real GDP is small. The second is that the overall TOT impact on neighboring countries is also small.

In summary, the macro and TOT effects of the PRC growth locomotive are positive, supporting the view that the PRC's growth presents more opportunities than risks. But almost all of these effects are small. If this appears counter-intuitive, then it could be because the framework employed here takes into account the offsetting effects. Therefore, although an awakening PRC will have an overall positive impact on the region, its entrance is unlikely to be dramatic.

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Table 2.1: Historical Simulation: Growth of Real GDP and Components, Population, Employment, and GDP Price Index (average annual growth rates 1997–2005, %)

	Real GDP	Real Consumption	Real Investment	Government Expenditure	Export Volumes	Import Volumes	Population	Employment	GDP price index
China, People's Rep. of	8.9	5.8	10.1	7.0	16.7	14.8	0.7	0.9	0.9
India	6.4	5.5	7.2	5.9	14.9	12.9	1.6	1.6	1.0
Indonesia	1.8	1.6	0.5	2.5	3.7	2.3	1.4	2.1	-0.5
Thailand	2.8	3.0	0.6	4.3	6.3	5.6	0.9	1.0	-1.7
Malaysia	3.7	3.9	-0.8	6.4	5.4	4.5	2.1	2.8	-1.0
Philippines	3.8	4.5	-0.7	0.5	3.1	1.9	1.9	3.0	-1.1
Singapore	4.4	2.1	-0.5	2.5	4.3	2.5	1.7	1.4	-1.8
Australia	3.4	3.8	6.0	2.7	3.5	6.9	1.2	2.0	2.8
Korea, Rep. of	4.1	2.4	1.8	3.3	10.2	7.2	0.6	1.0	1.3
Japan	1.0	0.8	0.1	2.3	2.9	1.6	0.2	-0.4	-0.4
US	3.2	3.8	4.6	2.5	3.1	7.1	1.0	1.1	2.1
R.O.W.	2.4	2.4	2.1	2.4	2.1	1.8	1.4	1.8	-0.1

GDP = gross domestic product, R.O.W. = rest of the world.

Source: Historical simulation.

Table 2.2: Historical Simulation: Output, Employment, and Technology
(average annual growth rates 1997–2005, %)

Item	Output		Employment		Technology*	
	PRC	US	PRC	US	PRC	US
Total	8.9	3.2	0.9	1.1	-4.4	-1.3
Agriculture	3.7	4.6	-0.1	-4.8	-3.4	-7.3
Mining	5.4	-0.2	-3.4	-0.2	-7.0	0.3
Manufacturing	10.7	1.6	0.3	-2.8	-5.2	-2.7
Utilities	10.3	2.4	0.5	-2.7	-3.1	-2.5
Construction	10.0	3.7	1.0	3.5	-6.0	0.0
Trade	11.3	4.0	0.7	1.6	-5.5	-1.8
Transport and Communication	11.5	5.3	0.3	-2.5	-4.6	-5.7
Other Services	8.7	3.3	3.6	2.3	-1.8	-0.4

PRC = People's Republic of China, US = United States.

* Negative numbers means technological improvement.

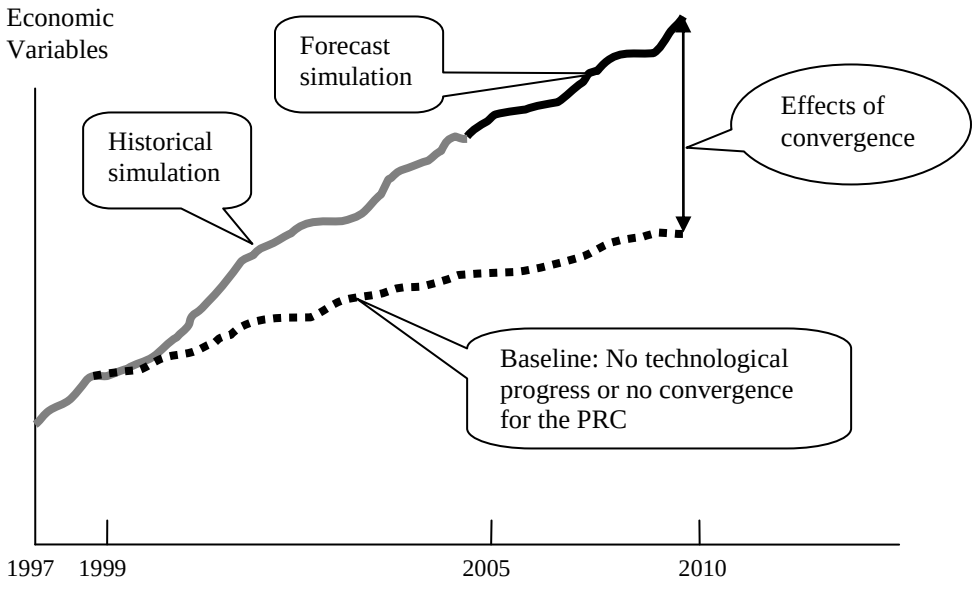
Source: The source for technology progress is the historical simulation. See discussion in Section 2.1 and statistical references for the sources of the output and employment data. The data from various sources were adjusted for data consistency.

Table 3.1: Forecast Simulation: Growth of Real GDP and Components
(average annual growth rates 2005–2010, %)

Item	Real GDP	Real Consumption	Real Investment	Government Expenditure	Export Volumes	Import Volumes
China, People's Rep. of	8.9	5.5	9.5	6.6	15.7	13.9
India	6.4	5.2	6.9	5.6	14.3	12.3
Indonesia	3.0	3.0	2.0	2.4	4.8	3.9
Thailand	3.7	3.5	1.0	4.4	6.6	5.5
Malaysia	4.8	4.5	1.6	6.3	6.6	6.0
Philippines	3.9	4.5	0.8	1.5	4.7	3.9
Singapore	5.3	2.4	1.0	2.8	4.8	3.1
Australia	3.4	3.8	6.1	2.7	3.5	7.0
Korea, Rep. of	4.8	2.4	1.8	3.3	10.0	7.0
Japan	1.2	1.1	0.2	2.4	2.8	1.8
US	3.2	3.9	4.7	2.5	3.2	7.2
R.O.W.	2.4	2.4	2.1	2.4	2.0	1.8

GDP = gross domestic product, R.O.W = rest of the world.
Source: Simulation results.

Figure 3.1: Historical, Forecast, and Baseline Simulations



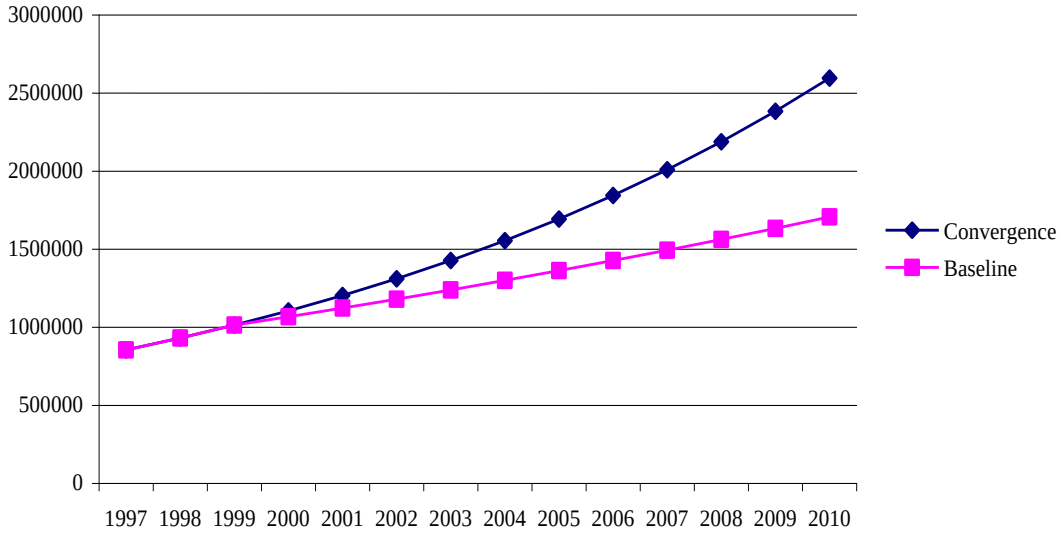
PRC = People's Republic of China.
Source: Simulation results.

Table 3.2: Baseline: Real GDP and Components, Population, Employment, and GDP Price Index
(average annual growth rates 1999–2010, %)

	Real GDP	Real Consumption	Real Investment	Government Expenditure	Export Volumes	Import Volumes	Population	Employment	TOT
China, People's Rep. of	4.8	2.3	3.9	3.4	11.8	10.1	0.7	0.8	0.7
India	6.5	5.4	7.3	5.8	14.3	12.8	1.5	1.8	0.4
Indonesia	3.0	2.9	1.9	2.3	4.9	3.9	1.3	1.8	-0.3
Thailand	3.7	3.6	1.1	4.6	6.7	5.7	0.9	0.9	-1.0
Malaysia	4.8	4.5	1.6	6.3	6.7	6.1	1.9	2.6	-0.2
Philippines	3.9	4.6	0.5	1.5	4.9	4.0	1.8	2.7	-1.1
Singapore	5.2	2.3	0.8	2.8	4.9	3.1	1.5	1.4	-0.5
Australia	3.4	3.8	5.9	2.7	3.5	6.8	1.1	1.5	2.2
Korea, Rep. of	4.7	2.3	1.6	3.2	9.9	6.9	0.5	0.7	0.3
Japan	1.2	1.1	0.1	2.4	2.6	1.5	0.1	-0.8	-1.0
US	3.2	3.8	4.5	2.5	3.1	7.0	1.0	0.9	0.2
R.O.W.	2.3	2.3	1.9	2.3	2.0	1.6	1.4	1.6	0.0

GDP = gross domestic product, R.O.W. = rest of the world, TOT = terms of trade.
Source: Simulation results.

Figure 3.2: PRC's Real GDP: With and Without Technology Convergence
(1999–2010, USD million)



GDP = gross domestic product, PRC = People's Republic of China.
Notes: TOT = terms of trade.

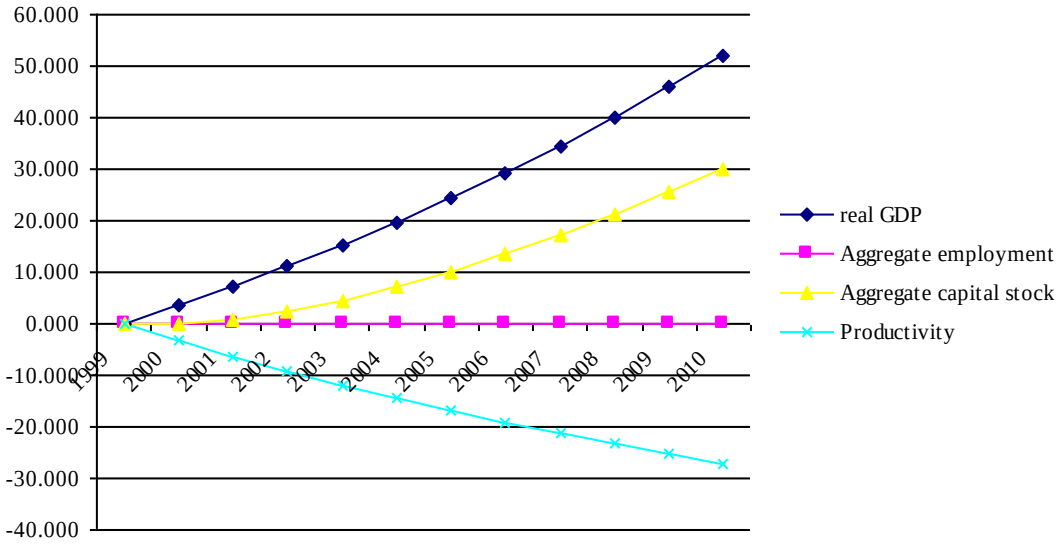
Source: Simulation results.

Table 3.3: The PRC's Convergence: Effects on the PRC's Macroeconomic Indicators (%)

Item	Baseline: Average Annual Growth Rates	The PRC's Convergence: Average Annual Growth Rates	The PRC's Convergence: Percentage Deviation from Baseline
	1999–2010	1999–2010	2010
Real GNP	5.2	8.8	44.2
Real GDP (Y)	4.8	8.9	52.1
Productivity* (A)	-1.3	-4.4	-29.6
Aggregate capital stock (K)	7.6	10.2	30.1
Aggregate employment (L)	0.8	0.8	0.0
Real consumption	2.3	5.5	40.1
Real investment	3.9	9.5	78.4
Export volumes	11.8	15.7	45.8
Import volumes	10.1	13.9	44.6
Real wage	3.2	6.3	38.2
TOT	0.7	-0.3	-10.4
GDP price index (P_g)	1.6	0.9	-7.9
Rental price (Q)	-0.3	0.5	8.6

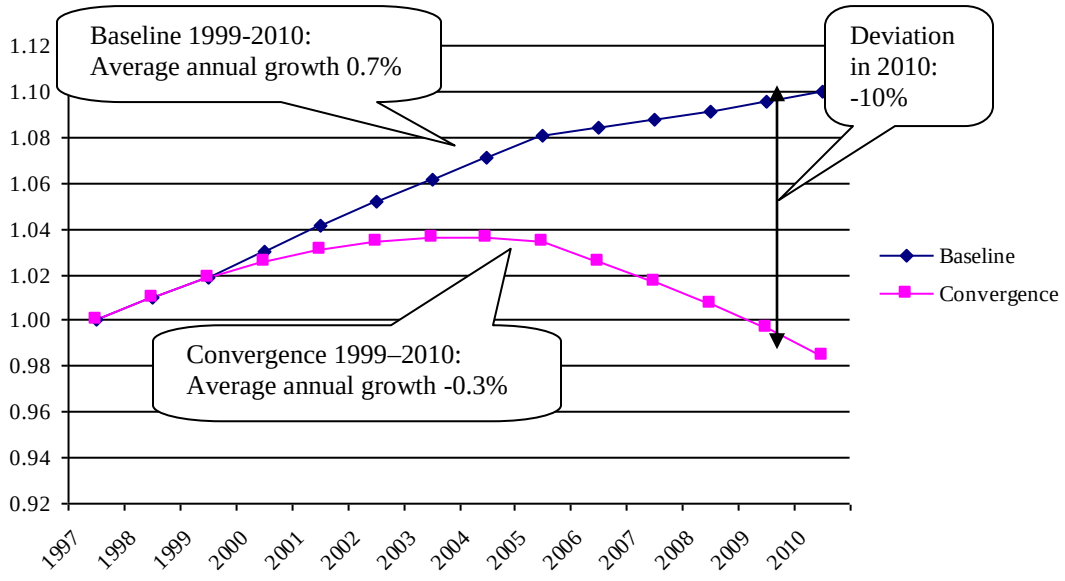
GDP = gross domestic product, GNP = gross national product, PRC = People's Republic of China, TOT = terms of trade.
* Negative numbers represent productivity improvements.
Source: Simulation results.

Figure 3.3: The PRC's Convergence: GDP, Capital, Employment, and Productivity
(percentage deviation from baseline 1999–2010, %)



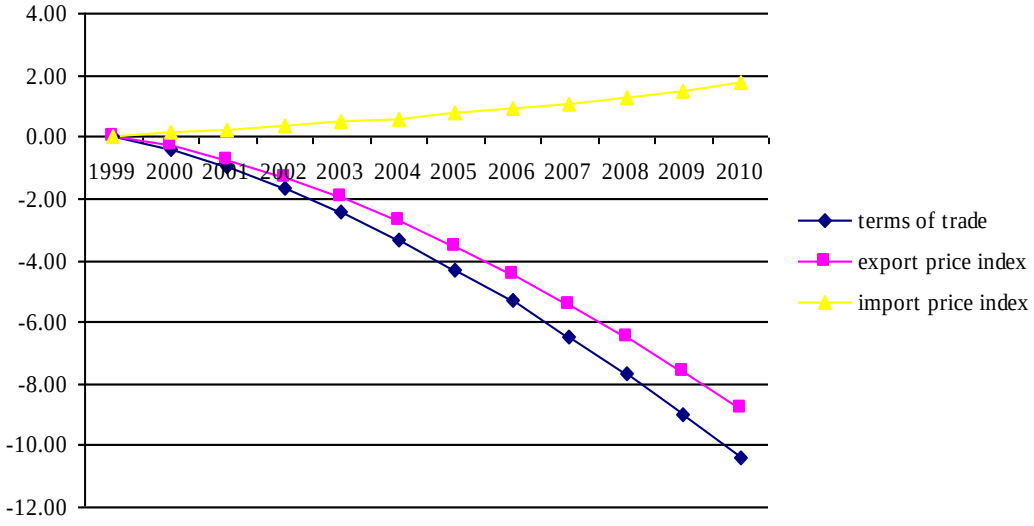
GDP = gross domestic product, PRC = People's Republic of China.
Note: Negative productivity numbers mean productivity improvements.
Source: Simulation results.

Figure 3.4: The PRC's Terms of Trade Declines Due to Technological Convergence
(index of Terms of Trade 1999–2010, 1997 = 1)



PRC = People's Republic of China, TOT = terms of trade.
Source: Simulation results.

Figure 3.5: The PRC's Technology Convergence: Export and Import Price Indexes
(percentage deviation from baseline 1999–2010, %)



PRC = People's Republic of China.
Source: Simulation results.

Table 3.4: The PRC's Technological Convergence: Effects on the PRC's Export and Import Prices

Item	GTAP Database: Shares of Exports or Imports by Commodity Groups (%)	Baseline Simulation: Shares of Exports or Imports by Commodity Groups (%)	PRC's Convergence: Percentage Deviation of Export or Import Prices from Baseline (%)
	1997	2010	2010
Total exports	**100.0**	**100.0**	**-8.8**
Agriculture	2.5	1.2	-1.2
Mining	1.9	0.5	-4.4
Coal	0.5	0.4	-8.3
Manufacturing	86.1	91.3	-9.0
Wearing apparel	11.0	10.6	-10.5
Electronic equipment	13.0	17.9	-10.9
Other manufactures	9.3	9.2	-10.4
Services	9.4	7.0	-7.6
Total imports	**100.0**	**100.0**	**1.8**
Agriculture	2.9	2.7	4.4
Plant-based fibers	0.6	0.4	4.6
Wool, silkworm cocoons	0.2	0.1	4.2
Mining	3.4	4.0	14.2
Oil	2.1	3.5	16.7
Manufacturing	83.4	77.9	0.6
Petroleum, coal prods	2.4	1.6	14.3
Services	10.3	15.4	1.4

GTAP = Global Trade Analysis Project, PRC = People's Republic of China.

Source: Simulation results.

Table 3.5: The PRC's Convergence: Effects on the PRC's Trade Volumes and Value-Added by Industries(%)

Item	Baseline Shares of Exports by Commodity Groups	Percentage Deviation of Export Volumes from Baseline	Baseline Shares of Imports by Commodity Groups	Percentage Deviation of Import Volumes from Baseline	GTAP Database: Percentage Shares of Value Added by Industries	Baseline Simulation: Percentage Shares of Value Added by Industries	The PRC's Convergence: Percentage Deviation from Baseline
	2010	2010	2010	2010	1997	2010	2010
Total	**100.0**	**45.8**	**100.0**	**44.6**	**100.0**	**100.0**	**52.1**
Agriculture	**1.2**	**11.0**	**2.7**	**53.1**	**20.9**	**16.3**	**36.2**
Mining	**0.5**	**9.3**	**4.0**	**81.4**	**4.4**	**0.9**	**39.9**
Manufacturing	**91.3**	**47.0**	**77.9**	**43.3**	**37.5**	**39.6**	**57.2**
Meat products	0.0	49.7	0.3	7.1	0.1	0.0	39.5
Other meat products	0.2	22.0	0.6	35.4	0.2	0.1	40.5
Vegetable oils and fats	0.1	18.0	0.8	39.7	0.1	0.0	35.6
Dairy products	0.0	30.2	0.1	27.4	0.0	0.0	38.4
Processed rice	0.1	22.6	0.1	14.9	1.5	0.9	27.3
Sugar	0.0	7.5	0.1	38.6	0.0	0.0	21.9
Food products nec	1.0	13.9	1.1	42.4	0.7	0.4	31.5
Beverages and tobacco products	0.4	37.8	0.6	26.3	0.9	0.6	47.5
Textiles	5.3	25.0	10.0	36.6	3.3	2.5	40.6
Wearing apparel	10.6	38.1	0.7	26.5	2.0	3.0	41.9
Leather products	6.3	22.6	1.7	27.4	1.0	1.2	27.6
Wood products	2.6	55.5	0.9	30.6	0.7	1.0	61.2
Paper products, publishing	0.7	52.1	3.5	37.6	1.5	1.1	66.7
Petroleum and coal products	0.3	44.6	1.6	36.2	0.6	0.5	55.8
Chemical, rubber, plastic products	6.8	35.4	13.1	46.9	4.2	3.3	51.1
Other mineral products	2.8	66.2	2.1	27.1	4.1	3.8	75.0
Ferrous metals	2.3	65.7	4.9	38.2	1.7	1.7	81.1
Nonferrous metals	1.3	63.4	2.9	47.0	0.5	0.6	76.3
Metal products	3.7	54.8	1.7	35.3	1.5	1.7	65.1
Motor vehicles and parts	0.8	65.4	1.6	45.2	0.9	0.7	75.7
Other transport equipment	1.9	74.2	1.5	38.4	0.8	0.8	77.9
Electronic equipments	17.9	58.2	11.7	51.3	1.9	4.4	63.9
Other machinery and equipment	17.0	55.8	15.3	48.9	6.4	7.2	67.7
Other manufactures	9.2	33.4	1.2	43.8	2.8	4.0	43.5
Services	**7.0**	**39.6**	**15.4**	**42.3**	**37.3**	**43.1**	**58.3**

GTAP = Global Trade Analysis Project, PRC = People's Republic of China.
Source: Simulation results.

Table 4.1: The PRC's Technological Convergence: Impact on Other Countries
(percentage deviation from baseline in 2010, %)

Item	TOT	Export Price Index	Import Price Index
China, People's Rep. of	-10.4	-8.8	1.8
India	-3.5	-1.2	2.3
Indonesia	2.8	4.4	1.6
Thailand	-1.5	-0.3	1.2
Malaysia	-0.1	-0.2	-0.1
Philippines	-0.9	0.0	0.9
Singapore	-0.2	1.1	1.3
Australia	1.4	1.7	0.4
Korea, Rep. of	-0.7	1.1	1.8
Japan	-0.8	0.1	0.9
US	0.5	0.7	0.3
R.O.W.	2.1	2.9	0.8

R.O.W. = rest of the world, TOT = terms of trade, PRC = People's Republic of China.
Source: Simulation results.

Table 4.2: The PRC's Technological Convergence: Effects on Japan's Trade

Item	GTAP Database: Shares of Exports or Imports by Commodity Groups (%)	Baseline Simulation: Shares of Exports or Imports by Commodity Groups (%)	The PRC's Convergence: Percentage Deviation of Export or Import Prices from Baseline (%)
	1997	2010	2010
Total exports	**100.0**	**100.0**	**0.1**
Agriculture	0.1	0.1	3.1
Mining	0.0	0.0	n.a.
Manufacturing	84.3	81.6	-0.3
Petroleum, coal products	0.2	0.5	13.3
Services	15.6	18.2	1.6
Total imports	**100.0**	**100.0**	**0.9**
Agriculture	5.1	3.5	2.0
Mining	12.0	15.4	11.2
Oil	7.12	11.0	16.3
Manufacturing	58.9	59.5	-2.2
Petroleum, coal products	2.0	2.3	14.1
Electronic equipment	9.7	11.4	-5.1
Services	24.0	21.6	1.7

GTAP = Global Trade Analysis Project, n.a. = not applicable, PRC = People's Republic of China, ROW = rest of the world, TOT = terms of trade, US = United States.
Sources: GTAP database and simulation results.

Table 4.3: The PRC's Technological Convergence: Effects on Japan's Import Prices (contribution by commodity groups to the deviation of import price index 2010)

Item	Baseline Shares in Total Imports by Commodity Groups (a)	Percentage Deviation in Import Prices by Commodity Groups (b)	Contribution to the Percentage Deviation in the Total Import Price Index by Commodity Groups (c) = (a)*(b)/100
Total imports	**100.0**	**0.9**	**0.9**
Agriculture	3.5	2.0	0.1
Mining	15.5	11.2	1.7
Manufacturing	59.4	-2.2	-1.3
Services	21.6	1.7	0.4

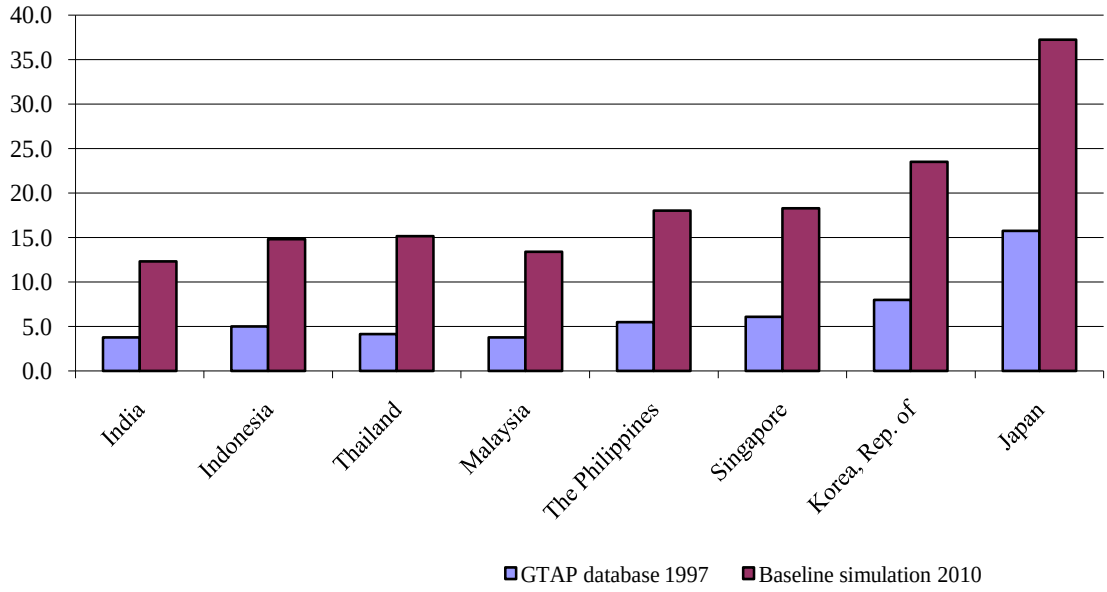
PRC = People's Republic of China.
Source: Simulation results.

Table 4.4: The PRC's Technological Convergence: Effects on the Republic of Korea's Trade

Item	GTAP Database: Shares of Exports or Imports by Commodity Groups (%)	Baseline Simulation: Shares of Exports or Imports by Commodity Groups (%)	The PRC's Convergence: Percentage Deviation of Export or Import Prices from Baseline (%)
	1997	**2010**	**2010**
Total exports	**100.0**	**100.0**	**1.1**
Agriculture	0.4	0.3	2.3
Mining	0.0	0.0	n.a.
Manufacturing	80.5	87.4	0.9
Petroleum, Coal products	2.5	3.6	14.9
Services	19.1	12.3	2.3
Total imports	**100.0**	**100.0**	**1.8**
Agriculture	3.6	2.2	2.5
Mining	13.6	14.8	13.0
Manufacturing	67.9	69.6	-0.8
Services	14.8	13.4	1.3

GTAP = Global Trade Analysis Project, n.a. = not applicable, PRC = People's Republic of China.
Sources: GTAP database and simulation results.

Figure 4.1: Share of Manufactured Imports from the PRC in Total Manufactured Imports (1997 and 2010, %)



GTAP = Global Trade Analysis Project, PRC = People's Republic of China.
Sources: GTAP database and simulation results.

Table 4.5: The PRC's Technological Convergence: Effects on India's Trade

Item	GTAP Database: Shares of Exports or Imports by Commodity Groups (%)	Baseline Simulation: Shares of Exports or Imports by Commodity Groups (%)	The PRC's Convergence: Percentage Deviation of Export or Import Prices from Baseline (%)
	1997	2010	2010
Total exports	**100.0**	**100.0**	**-1.2**
Agriculture	6.4	2.8	0.6
Mining	2.4	0.8	4.8
Manufacturing	70.6	80.5	-1.8
Services	20.5	15.9	0.7
Total imports	**100.0**	**100.0**	**2.3**
Agriculture	3.6	6.4	2.7
Mining	10.4	7.0	12.2
Manufacturing	69.4	70.7	1.3
Services	16.5	15.9	0.9

GTAP = Global Trade Analysis Project, PRC = People's Republic of China.
Source: Simulation results.

Table 4.6: The PRC's Convergence: Effects on Export Prices for the PRC and India

Item	GTAP database: shares in total exports by commodities		Baseline simulation: shares in total exports by commodities		PRC's convergence: percentage deviation of export prices from baseline	
	1997		2010		2010	
	PRC	India	PRC	India	PRC	India
Manufactures	86.1	70.6	91.3	80.5	-8.8	-1.2
Meat products	0.0	0.4	0.0	0.1	-9.2	-3.1
Other meat products	0.5	0.0	0.2	0.0	-4.3	-0.7
Vegetable oils and fats	0.2	2.3	0.1	1.0	-2.9	0.1
Dairy products	0.0	0.0	0.0	0.0	-5.8	-0.5
Processed rice	0.1	1.8	0.1	1.1	-5.9	-2.6
Sugar	0.1	0.5	0.0	0.3	-1.0	-0.5
Food products nec	1.8	4.0	1.0	2.3	-3.0	-1.1
Beverages and tobacco products	0.4	0.1	0.4	0.1	-6.1	-1.0
Textiles	8.6	13.4	5.3	9.5	-6.6	-1.1
Wearing apparel	11.0	8.9	10.6	15.5	-10.5	-4.4
Leather products	8.8	2.9	6.3	4.4	-8.8	-3.2
Wood products	1.7	0.4	2.6	0.6	-7.9	-1.3
Paper products, publishing	0.7	0.3	0.7	0.3	-8.3	-0.3
Petroleum and coal products	0.5	0.5	0.3	0.8	6.4	14.1
Chemical, rubber, plastic products	6.8	8.6	6.8	7.1	-4.9	1.1
Other mineral products	2.2	1.4	2.8	2.4	-9.3	-1.5
Ferrous metals	1.8	2.2	2.3	3.5	-9.2	-1.1
Nonferrous metals	1.0	0.8	1.3	0.9	-7.2	-0.2
Metal products	2.9	2.2	3.7	5.9	-8.7	-2.7
Motor vehicles and parts	0.5	1.2	0.8	2.2	-5.4	-0.8
Other transport equipment	1.4	0.9	1.9	1.2	-7.2	-1.6
Electronic equipment	13.0	1.4	17.9	1.3	-10.9	-3.4
Other machinery and equipment	12.9	4.3	17.0	5.1	-9.0	-2.0
Other manufactures	9.3	12.1	9.2	14.9	-10.4	-3.9

GTAP = Global Trade Analysis Project, PRC = People's Republic of China.
Sources: GTAP database and simulation results.

Table 4.7: The PRC's Technological Convergence: Effects on Indonesia's Trade

Item	GTAP Database: Shares of Exports or Imports by Commodity Groups (%)	Baseline Simulation: Shares of Exports or Imports by Commodity Groups (%)	The PRC's Convergence: Percentage Deviation of Export or Import Prices from Baseline (%)
	1997	2010	2010
Total exports	**100.0**	**100.0**	**4.4**
Agriculture	3.9	2.6	2.0
Mining	20.7	26.2	12.6
Manufacturing	63.8	59.0	0.4
Services	11.6	12.3	2.5
Total imports	**100.0**	**100.0**	**1.6**
Agriculture	5.3	6.3	2.1
Mining	2.6	4.9	13.5
Manufacturing	70.7	65.5	1.1
Services	21.4	23.3	0.6

GTAP = Global Trade Analysis Project, PRC = People's Republic of China.
Source: Simulation results.

Table 4.8: The PRC's Technological Convergence: Effects on Malaysia's Trade

Item	GTAP Database: Shares of Exports or Imports by Commodity Groups (%)	Baseline Simulation: Shares of Exports or Imports by Commodity Groups (%)	The PRC's Convergence: Percentage Deviation of Export or Import Prices from Baseline (%)
	1997	2010	2010
Total exports	**100.0**	**100.0**	**-0.2**
Agriculture	1.8	1.7	5.3
Mining	4.3	4.9	12.5
Manufacturing	78.6	77.7	-1.5
Services	15.3	15.7	0.4
Total imports	**100.0**	**100.0**	**-0.1**
Agriculture	2.2	2.5	1.8
Mining	0.9	1.7	10.6
Manufacturing	81.6	70.8	-0.5
Services	15.3	24.9	0.1

GTAP = Global Trade Analysis Project, PRC = People's Republic of China.
Source: Simulation results.

Table 4.9: The PRC's Technological Convergence: Effects on Singapore's Trade

Item	GTAP Database: Share of Exports or Imports by Commodity Groups (%)	Baseline Simulation: Share of Exports or Imports by Commodity Groups (%)	The PRC's Convergence: Percentage Deviation of Export or Import Prices from Baseline
	1997	2010	2010
Total exports	**100.0**	**100.0**	**1.1**
Agriculture	0.5	0.4	1.3
Mining	0.0	0.0	1.8
Manufacturing	75.4	76.6	0.6
petroleum and coal prods	5.6	8.8	15.8
electronic equipment	44.9	42.4	-3.1
Services	24.0	22.9	2.1
Total imports	**100.0**	**100.0**	**1.3**
Agriculture	1.3	1.0	1.4
Mining	5.5	9.5	16.1
Manufacturing	82.7	74.4	-0.8
petroleum and coal prods	3.7	5.3	13.6
electronic equipment	33.2	29.4	-3.7
Services	10.5	15.1	0.7

GTAP = Global Trade Analysis Project, n.a. = not applicable, PRC = People's Republic of China.
Source: Simulation results.

Table 4.10: The PRC's Technological Convergence: Effects on Thailand's Trade

Item	GTAP Database: Shares of Exports or Imports by Commodity Groups (%)	Baseline Simulation: Shares of Exports or Imports by Commodity Groups (%)	The PRC's Convergence: Percentage Deviation of Export or Import Prices from Baseline
	1997	2010	2010
Total exports	**100.0**	**100.0**	**-0.3**
Agriculture	1.9	1.5	3.8
Mining	0.3	0.5	16.3
Manufacturing	77.4	76.7	-1.1
electronic equipment	25.1	25.0	-3.3
Other machinery,equipment	10.5	13.4	-1.9
Services	20.5	21.3	1.5
Total imports	**100.0**	**100.0**	**1.2**
Agriculture	2.2	2.5	2.7
Mining	7.1	7.4	15.0
Manufacturing	75.5	64.9	-0.6
electronic equipment	16.6	12.9	-3.3
Other machinery,equipment	20.5	13.3	-1.4
Services	15.2	25.2	0.7

GTAP = Global Trade Analysis Project, PRC = People's Republic of China.
Source: Simulation results.

Table 4.11: The PRC's Technological Convergence: Effects on the Philippine's Trade

Item	GTAP Database: Shares of Exports or Imports by Commodity Groups (%)	Baseline Simulation: Shares of Exports or Imports by Commodity Groups(%)	The PRC's Convergence: Percentage Deviation of Export or Import Prices from Baseline (%)
	1997	2010	2010
Total exports	**100.0**	**100.0**	**0.0**
Agriculture	1.6	1.5	4.7
Mining	0.8	0.7	3.1
Manufacturing	62.2	56.6	-1.2
electronic equipment	37.2	32.6	-2.4
Services	35.5	41.3	1.1
Total imports	**100.0**	**100.0**	**0.9**
Agriculture	2.4	2.6	1.8
Mining	5.6	7.6	13.9
Manufacturing	69.7	60.3	-1.1
electronic equipment	23.9	18.6	-3.0
Services	22.4	29.5	0.7

GTAP = Global Trade Analysis Project, PRC = People's Republic of China.
Source: Simulation results.

Table 5.1: The PRC's Convergence: Effects on Export Volumes by Commodity Groups (percentage deviation from the baseline 2010, %)

Item	India	Indonesia	Thailand	Malaysia	Philippines	Singapore	Korea, Rep. of	Japan
Total exports	**0.0**	**-1.8**	**-0.3**	**-1.1**	**-1.8**	**-0.5**	**0.7**	**2.6**
Agriculture	6.2	2.6	2.8	6.8	9.4	0.4	2.8	7.7
Mining	8.5	2.5	3.3	2.0	3.4	n.a.	n.a.	n.a
Manufactures	-1.7	-4.1	-1.8	-3.1	-6.3	-2.0	0.0	1.2
Services	7.3	2.0	4.9	8.2	3.6	4.8	6.0	8.6

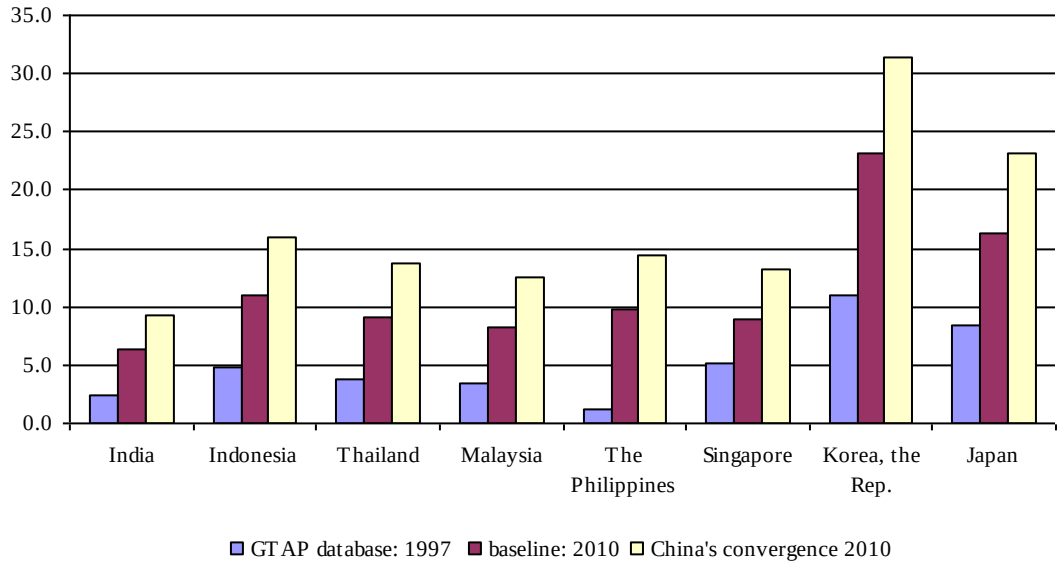
n.a. = not applicable, PRC = People's Republic of China.
Source: Simulation results.

Table 5.2: The PRC's Convergence: Effects on Imports into the US, Japan, ROW, and the PRC (percentage deviation from the baseline 2010, %)

Item	Import volumes into			
	US	**Japan**	**R.O.W.**	**China, People's Rep. of**
Total (from all sources)	**1.8**	**3.2**	**1.4**	**44.6**
China, People's Rep. of	42.7	39.0	51.2	n.a.
India	-6.6	-6.2	-1.6	47.6
Indonesia	-10.7	-8.8	-6.1	42.9
Thailand	-7.5	-9.9	-2.3	49.1
Malaysia	-8.8	-9.5	-2.0	51.1
Philippines	-9.7	-15.8	-4.1	42.6
Singapore	-10.1	-12.5	-4.4	46.8
Korea, Rep. of	-14.1	-17.5	-9.0	36.7
Japan	-7.0	n.a.	-3.8	44.7

Source: Simulation results.

Figure 5.1: The Share of Exports to the PRC in Total Exports
(1997 and 2010, %)



GTAP = Global Trade Analysis Project, PRC = People's Republic of China.
Source: GTAP database and simulation results.

Table 5.3: The PRC's Convergence: Effects on the Exports and Imports of Manufactures
(percentage deviation from the baseline 2010, %)

Item	Electronic equipment		Machinery and other equipment		Chemical, rubber, and plastic products		Electronic equipment		Machinery and other equipment		Chemical, rubber, and plastic products	
	Exports to the world	Exports to the PRC	Exports to the world	Exports to the PRC	Exports to the world	Exports to the PRC	Imports from the world	Imports from the PRC	Imports from the world	Imports from the PRC	Imports from the world	Imports from the PRC
China, People's Rep. of	58.2	n.a.	55.8	n.a.	35.4	n.a.	51.3	n.a.	48.9	n.a.	46.9	n.a.
India	-6.6	62.7	0.8	61.3	5.0	57.8	-1.8	57.0	-4.3	56.4	-2.1	33.7
Indonesia	-10.4	64.5	-1.9	61.7	2.1	53.7	3.3	58.8	0.1	65.4	-1.4	36.1
Thailand	-5.3	66.7	0.4	59.5	8.1	50.9	-3.6	56.3	-0.7	60.7	-0.3	38.4
Malaysia	-7.6	63.5	1.8	61.0	8.0	59.2	-3.5	62.3	-0.1	57.8	-0.6	38.3
Philippines	-9.4	52.8	-2.2	53.0	6.4	43.9	-5.8	61.8	1.1	51.1	-1.8	34.8
Singapore	-5.0	62.5	-0.8	53.9	4.7	52.4	-3.4	53.1	-0.3	51.4	0.8	39.0
Korea, Rep. of	-8.3	47.1	0.1	44.0	8.2	35.5	-1.7	51.7	-2.5	61.0	4.4	41.4
Japan	-3.7	48.5	0.7	49.4	4.9	48.6	13.0	57.2	8.5	45.8	0.2	32.8

PRC = People's Republic of China, n.a. = not applicable.
Source: Simulation results.

Table 5.4: The PRC's Convergence: Effects on Value Added by Sector
(percentage deviation from the baseline 2010, %)

Item	India	Indonesia	Thailand	Malaysia	Philippines	Singapore	Korea, Rep. of	Japan
GDP	**-1.1**	**0.0**	**-0.2**	**0.2**	**0.0**	**0.6**	**0.5**	**0.0**
Agriculture	0.2	0.2	0.8	1.5	0.0	0.5	0.1	0.1
Mining	1.9	0.6	0.4	1.4	0.7	n.a.	-0.2	0.1
Manufactures	-1.9	-1.9	-2.1	-3.2	-2.5	-2.4	-0.4	-0.8
Services	-0.9	0.5	0.1	3.2	0.6	1.4	0.4	0.2

GDP = gross domestic product, n.a. = not applicable, PRC = People's Republic of China.
Source: Simulation results.

Table 5.5: The PRC's Convergence: Effects on Macroeconomic Variables of Neighboring Countries (percentage deviation from the baseline 2010, %)

Item	India	Indonesia	Thailand	Malaysia	Philippines	Singapore	Korea, Rep. of	Japan
Real GNP	-1.7	1.1	-1.1	0.4	-0.6	1.0	0.5	-0/1
Real GDP	-1.1	0.0	-0.2	0.2	0.0	0.6	0.5	0.0
Capital stock	-1.5	0.0	-0.7	-0.4	0.1	0.1	0.2	-0.1
Employment	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
GDP price index	-2.8	1.6	-2.0	-1.1	-0.6	-1.2	-0.1	-0.9
Capital rental	-3.6	-0.9	-2.2	-1.8	-0.7	-1.0	0.2	-1.1
Real wage	-3.0	-2.1	-2.5	-2.5	0.1	0.7	0.0	-0.5
TOT	-3.5	2.8	-1.5	-0.1	-0.9	-0.2	-0.7	-0.8
Rates of return	-0.8	-0.1	-0.4	0.4	0.2	0.7	0.9	0.1

GDP = gross domestic product, GNP = gross national product, PRC = People's Republic of China, TOT = terms of trade.
Source: Simulation results.

Table 5.6: Positive and Negative Effects on Neighboring Countries' Terms of Trade

Item	Positive effects on TOT for:	Negative effects on TOT for:
Increase in the world price for energy and primary inputs	Net exporters of energy and primary inputs such as Australia and Indonesia	Net importers of energy and primary inputs such as Japan and the Republic of Korea (Korea)
Decrease in the world price for manufactured goods	Importers of manufactured goods, especially imports from the PRC, such as Japan and Korea	Exporters of manufactured goods, especially those exporting similar goods to the PRC, such as India
Increase in the world price for services exports	The PRC's neighboring countries [a]	

TOT = terms of trade, PRC = People's Republic of China.
[a] Neighboring countries include India, Indonesia, Korea, Japan, Malaysia, Philippines, Singapore, and Thailand.
Source: Simulation results.

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The Awakening Chinese Economy: Macro and Terms of Trade Impacts on 10 Major Asia-Pacific Countries

In this paper, Yin Hua Mai, Phillip Adams, Peter Dixon and Jayant Menon examine the impact that an awakening People's Republic of China (PRC) is likely to have on the growth and terms of trade of its neighbours. Using a multi-country model, they find that PRC's technological convergence raises the world prices for mining products and lowers those for manufactures. Overall, the effects are relatively small, however. Therefore, although an awakening PRC will have a positive impact on the region, it is unlikely to make a dramatic entrance.

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